4.—Peltacystia gen. nov.: a microfossil of uncertain affinities from the Permian of Western Australia

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Manuscript received 18th May, 1965; accepted 18th January, 1966.

Abstract

The name *Peltacystia* gen. nov. is proposed as a form genus to accommodate cutinised microfossils of unusual structure, which occur commonly in Upper Permian sediments in the Perth Basin, Western Australia. Three species *P. venosa* sp. nov., *P. calvitium* sp. nov., and *P. monile* sp. nov. are defined. The stratigraphic distribution of the genus is reviewed and its possible affinities and palaeoecological significance are discussed briefly.

Introduction

Since November, 1964, the junior author has been investigating the palynology of Upper Permian sediments occurring in the northern part of the Perth Basin, Western Australia. These deposits have been penetrated by a number of boreholes, particularly in the Wicherina-Eradu district where they contain poor quality, lenticular, coal seams. Because of faulting and the presence of disconformities within the section, the Permian stratigraphy of the northern Perth Basin is difficult to interpret. There is little doubt, on palynological grounds, that the coal-bearing succession in the Eradu district correlates with the Wagina Sandstone in the Irwin River district which has been recently assigned to the Upper Permian (Balme 1964).

Microfloras from Upper Permian sediments in the Perth Basin are in some ways unusual, when compared with those of similar age from other parts of Western Australia. Disaccate pollen are often comparatively rare and some of the common trilete spores have not been recorded elsewhere. A striking feature too, of many assemblages, especially those from coals, is their high content of cutinised microfossils which lack the typical morphographic characters of spores and pollen grains of vascular plants. Most specimens in this category can be accommodated in existing form genera, but some of the more distinctive and common types do not appear to have been yet described. The purpose of this account is to define and illustrate three species which have been previously noted in Permian sediments from other sedimentary basins, but never in sufficient numbers to enable their structure and variation to be confidently interpreted.

Sources of samples

Samples containing one or more of the species under discussion were obtained from boreholes and shafts sunk in the northern Perth Basin by various authorities. Type specimens of all three species were taken from a single sample of coal from a seam encountered in a borehole which penetrated the Wagina Sandstone near Woolaga Creek in the Irwin River district. Specimens used for additional illustration were obtained from two samples recovered from bores in the Eradu-Wicherina district. Details of these three samples are as follows:

Sample No. 49741: Inferior canneloid coal at 91-95 feet, U.W.A. 4 (Woolaga Creek) Borehole (29° 10′ 36″ S., 115° 40′ 24″ E.), Irwin River District, Perth Basin, Western Australia. Wagina Sandstone, Upper Permian.

Sample No. 43290: Grey siltstone at 367-373 feet, Public Works Department Bore X49 (28° 41′ 9″ S., 114° 59′ 38″ E.), Wicherina District, Perth Basin, Western Australia. Wagina Sandstone, Upper Permian.

Sample No. 43283: Coal at 135-157 feet, Eradu Coal Bore No. 5 (28° 41′ 34″ S., 115° 2′ 0″ E.), Eradu District, Perth Basin, Western Australia. Wagina Sandstone, Upper Permian.

Additional records of occurrences of the species described are listed in a subsequent section of the paper.

Storage of specimens

Types and illustrated specimens are mounted singly in glycerin jelly and sealed with beeswax and clear varnish. They are stored in the museum of the Department of Geology, University of Western Australia, and specimen numbers given in the text refer to the catalogue of collections of that repository.

Techniques

Clastic sediments were prepared for examination by boiling a few grams of sample in 50% hydrofluoric acid and treating the organic residue with Schultze solution followed by weak alkali. Coals were oxidised with concentrated nitric acid and the alkali soluble fraction subsequently removed with 5% sodium hydroxide.

Systematic descriptions

Genus **Peltacystia** gen. nov.

Type species.—*Peltacystia venosa* sp. nov., Wagina Sandstone, Perth Basin, Western Australia. Upper Permian.

Diagnosis.—Acid insoluble microfossils of uncertain function. Body spheroidal or oblate spheroidal with a sharply defined equatorial line of weakness along which the body tends to split into two symmetrical halves. Each hemisphere divided into a polar and equatorial zone by a circumpolar ridge, or ring of sculptural processes, which encircles the body about half way between the pole and the equator.

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Additional circumpolar ridges or rings of processes may be present in the polar zones and the remainder of the body wall may be laevigate or variously sculptured.

Remarks and comparisons.—*Peltacystia* belongs to that group of form genera which is primarily characterised by a tendency to rupture equatorially along a sharply defined line of dehiscence. In *Peltacystia* rupture is normally complete and detached halves are much more common than intact specimens. *Schizosporis* Cookson and Dettmann differs mainly in its lack of circumpolar ornament and in *Schizocystia* Cookson and Eisenack the shell tends to be quadrilateral with concave sides. *Lecaniella* Cookson and Eisenack, from the Cretaceous of Western Australia may well be a closely related form. *Lecaniella margostriata* Cookson and Eisenack resembles in some ways the separated hemispheres of *Peltacystia venosa* sp. nov. and Cookson and Eisenack (1962) suggested the possibility that *Lecaniella* represented the ruptured halves of originally sub-spheroidal bodies. They were, however, unable to confirm this by finding specimens which were certainly intact. If *Lecaniella* is eventually proved to have arisen by equatorial rupture it is distinguishable from *Peltacystia* in its lack of a well-defined circumpolar ridge. The illustrations given by Jansonius (1962, plate 16, figures 2-4) of *Gretespora concentrica* Jansonius are faintly reminiscent of some ruptured specimens of *Peltacystia*, but in his diagnosis Jansonius makes it clear that his species is a flattened hollow body bearing a concentric marginal fold. A form illustrated by Alpern (1959, plate 17, figure 432) as *Nuskoisporites* ?sp. may be assignable to *Peltacystia*. Alpern's specimen came from the Westphalian of Lorraine and may, therefore, be a much older record of the genus than any reported in the present account.

Derivatio nominis.—Greek πελτη a small shield, from the shape of the ruptured halves.

Affinities.—On morphological analogy with living forms the most obvious inference is that the various species of *Peltacystia* represent unicellular members of the Chlorococcales, although there seems no possibility of demonstrating this. The mode of rupture resembles that of modern artificial genera such as *Desmatractum* and *Octogoniella* and the sculptural pattern of *Peltacystia venosa* sp. nov. recalls the surface ornament of *Trochischia*. An algal origin has been suggested by several authors (e.g. Cookson and Eisenack 1962, Churchill 1960) for other form genera with a similar dehiscence mechanism to *Peltacystia*, although the comparisons have been quite properly guarded.

That *Peltacystia* is not the spore or pollen grain of a vascular plant is further suggested by two observations during the present investigation. Firstly, its wall differs chemically from that of spores and pollen grains and is more resistant to the action of Schultze solution and alkali. This may be demonstrated by oxidising slightly weathered sediments until the spores and pollen grains are destroyed, or swollen almost beyond recognition. Specimens of *Peltacystia* (and, incidentally, various other microfossils of suspected algal origin) are, however, apparently unaffected. Secondly, the occurrence and associations of *Peltacystia* hint at a non-vascular origin. Although it has been found in marine sediments it has so far only been recorded in high concentrations from coals and clastic sediments closely associated with coals. Where it occurs abundantly *Peltacystia* is invariably accompanied by large numbers of other microfossils of probable non-vascular origin. Such microfossils are assignable to, among others, the form genera *Pilasporites* Balme and Hennelly, *Tetraporina* (Naumova), *Schizosporis* Cookson and Dettmann and *Circulisporites* de Jersey. Microscopic algal colonies resembling *Botryococcus* are also associated with *Peltacystia* in some assemblages. On the available evidence, therefore, large numbers of *Peltacystia* may be taken to characterise continental, fresh or brackish water, sediments. A more reliable assessment of its palaeoecological significance may be possible when detailed palynological studies of Permian sediments in the Perth Basin have been completed.

Known stratigraphic distribution.—Artinskian and Upper Permian. Specimens have only rarely been found in sediments older than Upper Permian, but in view of the apparent facies dependence of *Peltacystia*, any firm conclusions concerning its biostratigraphic significance would be premature.

Peltacystia venosa sp. nov.

Figure 1, a-b. Figure 2, a-f. Figure 3, f-k.

Holotype.—53992.

Paratypes.—53993, 53994, 53995.

Diagnosis.—Body sub-spheroidal, splitting by equatorial rupture into two symmetrical halves. Intact specimens rare. Wall 1-2μ thick. Each hemisphere divided into a polar and equatorial zone by a low, narrow, circumpolar ridge bearing papillate or capitate processes 1-2μ in basal diameter and 3-5μ long. Additional circumpolar ridges or rings of processes may be present in the polar zone. Remainder of surface reticulate with low muri about 1μ wide which basically radiate from the polar area, but form a complex pattern by dichotomy and anastomosis. Muri terminate by merging into the circumpolar processes. Equatorial zone bearing radiating muri which arise in the processes of the circumpolar ridge, sometimes dichotomise and terminate with a slight thickening at the line of equatorial rupture. Periphery of ruptured specimens notched.

Dimensions.—Equatorial diameter (40 specimens) 35-65μ (mean 45μ).

Descriptions.—Holotype 53992: intact specimen preserved in oblique view; equatorial diameter 48μ, polar diameter about 46μ. Paratype 53993: ruptured specimen in equatorial view; equatorial diameter 49μ, estimated polar diameter 48μ. Paratype 53994: ruptured specimen in polar view, equatorial diameter 43μ. Paratype 53995: intact specimen in oblique view, equatorial diameter 49μ, estimated polar diameter 46μ.

Locus typicus.—Coal at 91-95 feet, U.W.A. 4 (Woolaga Creek) Borehole, Perth Basin, Western Australia. Wagina Sandstone, Upper Permian.

Derivatio nominis.—Latin *venosus* = veined.

Remarks and comparisons.—*Peltacystia venosa* is the most common and widely distributed of the three species of the genus so far recognised. It is known from Upper Permian sediments in the Perth, Canning and Collie-Muja Basins and is easily recognised even when poorly preserved. It is distinguished from other species of *Peltacystia* by the reticulate sculpture of its polar zones.

Known stratigraphic range.—Upper Permian.

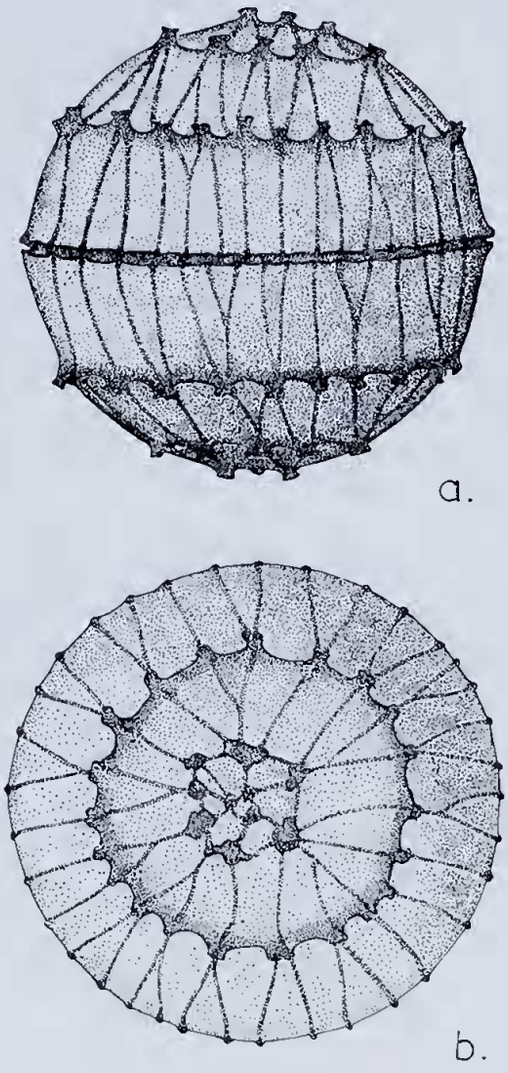

Figure 1.—*Peltacystia venosa* Balme and Segroves. Reconstruction of intact specimen. a. Equatorial view. b. Polar view. X1000.

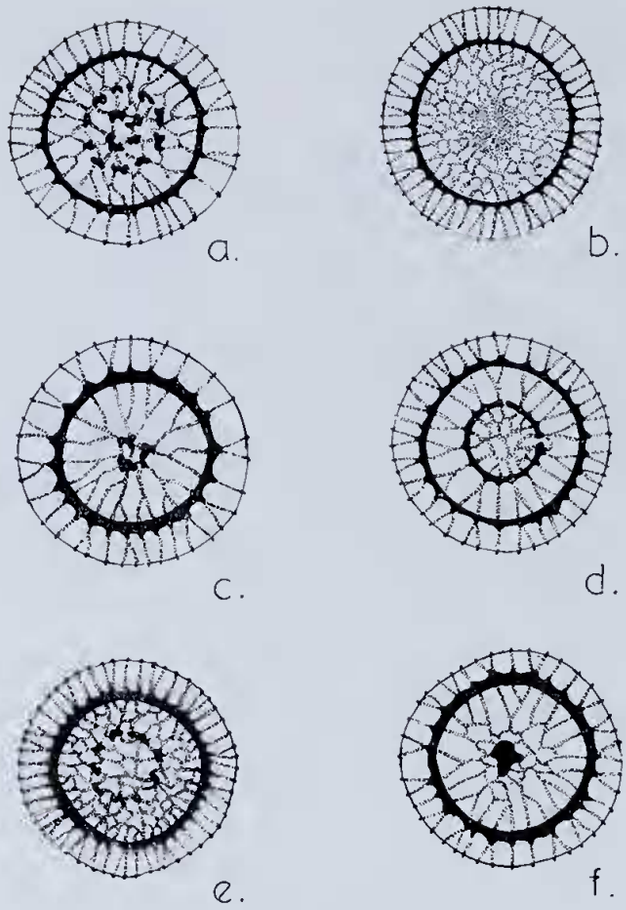

Figure 2.—*Peltacystia venosa* Balme and Segroves. a-f. Polar views showing variations in sculptural patterns on six selected specimens. X500.

Peltacystia monile sp. nov.
Figure 4b. Figure 3, a-e.

Holotype.—53996.

Paratypes.—53997, 53998.

Diagnosis.—Body oblate spheroidal, splitting by equatorial rupture into two symmetrical halves. Detached halves more common than intact specimens. Wall about 1μ thick. Each hemisphere bearing a circumpolar ring of small verrucate or papillate processes lying about half way between the pole and equator. Individual processes 1-2μ in basal diameter, 1-2μ high and less than 1μ apart. Bases of processes joined in some specimens to form a continuous subcristate ridge. Scattered processes sometimes present in the polar zone. Remainder of surface laevigate or faintly punctate, equatorial periphery of ruptured specimens finely notched.

Dimensions.—Equatorial diameter (20 specimens) 28-40μ (mean 33μ).

Descriptions.—Holotype: intact specimen preserved in oblique view, equatorial diameter 34μ, polar diameter about 31μ. Paratypes: separated

Figure 3.—Opposite.

Figure 3.—All magnifications X750. a. *Peltacystia monile* Balme and Segroves. 53999. Intact specimen in oblique view. b. *P. monile.* Holotype 53996. Intact specimen oblique view. c. *P. monile.* 54000. Ruptured specimen in polar view. d. *P. monile.* Paratype 53997. Ruptured specimen in polar view. e. *P. monile.* Paratype 53998. Ruptured specimen in polar view. f. *Peltacystia venosa* Balme and Segroves. Ruptured specimen in polar view. g. *P. venosa.* 54005. Ruptured specimen in polar view. h. *P. venosa.* Paratype 53994. Ruptured specimen in polar view. i. *P. venosa.* Paratype 53993. Ruptured specimen in equatorial view. j. *P. venosa.* Paratype 53995. Intact specimen in oblique view. k. *P.venosa.* Holotype 53992. Intact specimen in oblique view. l. *Peltacystia calvitium* Balme and Segroves. Intact specimen in oblique view. m. *P. calvitium.* Paratype. 54002. Intact specimen in polar view. n. *P. calvitium.* Holotype 54001. Intact specimen in equatorial view. o. *P. calvitium.* Paratype 54003. Intact specimen in equatorial view.

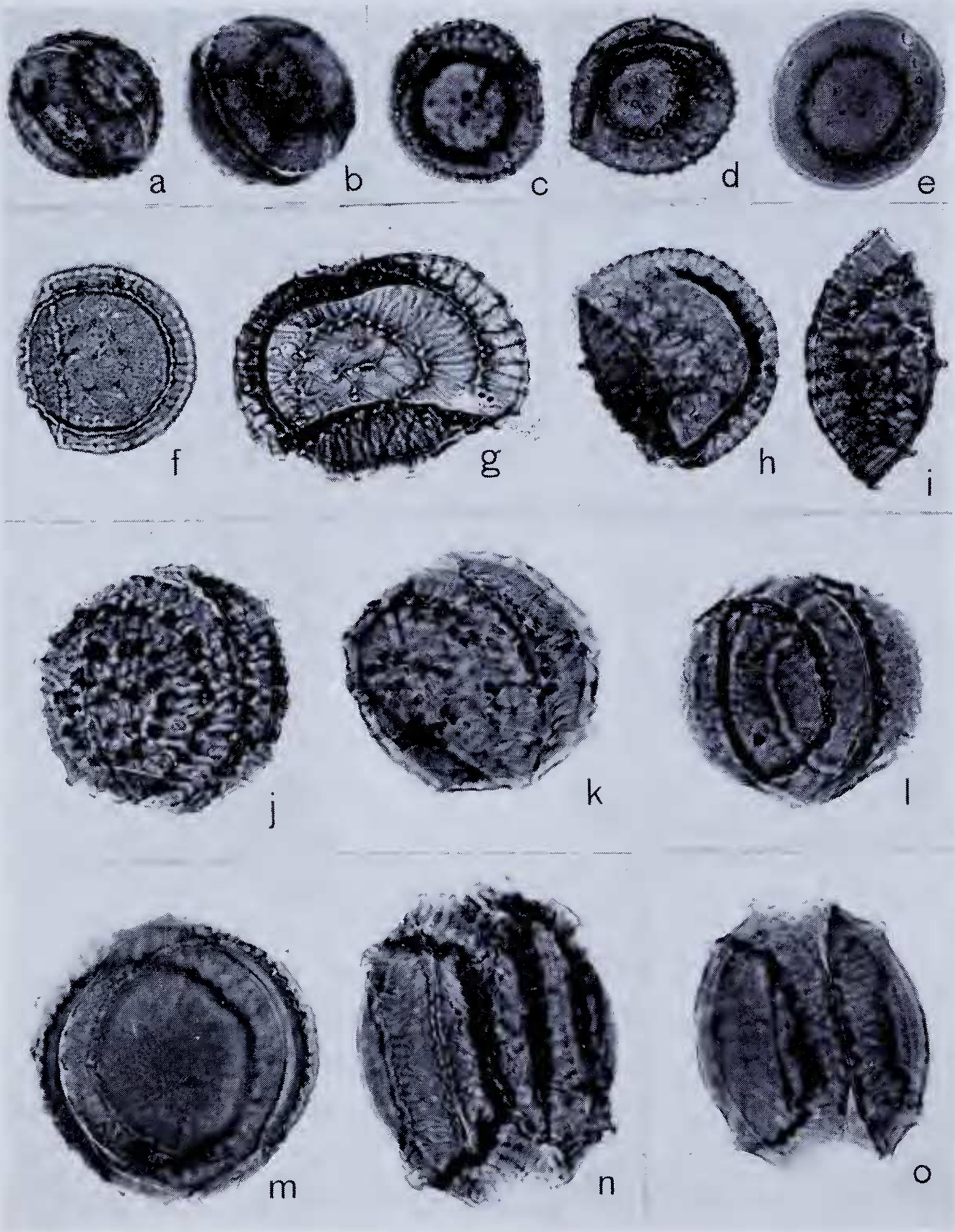

Figure 3.

halves in polar view, both with about 5 small sculptural processes scattered in the polar area. In paratype 53998 the sculptural elements of the circumpolar ring are more numerous than in 53997.

Locus typicus.—Coal at 91-95 feet, U.W.A. 4 (Woolaga Creek) Borehole, Perth Basin, Western Australia. Wagina Sandstone, Upper Permian.

Derivatio nominis.—Latin *monile* = a necklace.

Remarks and Comparisons.—*Peltacystia monile* has been recorded from the Perth, Collie-Muja and Canning Basins, but may have been overlooked in material from other areas. It is smaller than *peltacystia venosa* and lacks reticulate sculpture.

Known stratigraphic range.—Upper Permian.

Peltacystia calvitium sp. nov.

Figure 4a. Figure 3, l-o.

Holotype.—54001.

Paratypes.—54002, 54003.

Diagnosis.—Body oblate spheroidal splitting by equatorial rupture into two symmetrical halves. Intact specimens more common than ruptured, at least in the type material. Wall 2-4μ thick, slightly thicker in the polar than in the equatorial zones. Each hemisphere bearing a clearly defined circumpolar ridge 2-5μ high encircling the body about half way between the pole and the equator. Top of ridge weakly undulate and sometimes bearing grana, but without heavy processes. Polar zones laevigate or faintly punctate. Equatorial zone with poorly defined, dichotomising, striae which arise on the circumpolar ridge and terminate at the line of equatorial rupture. Equatorial periphery weakly notched in ruptured specimens.

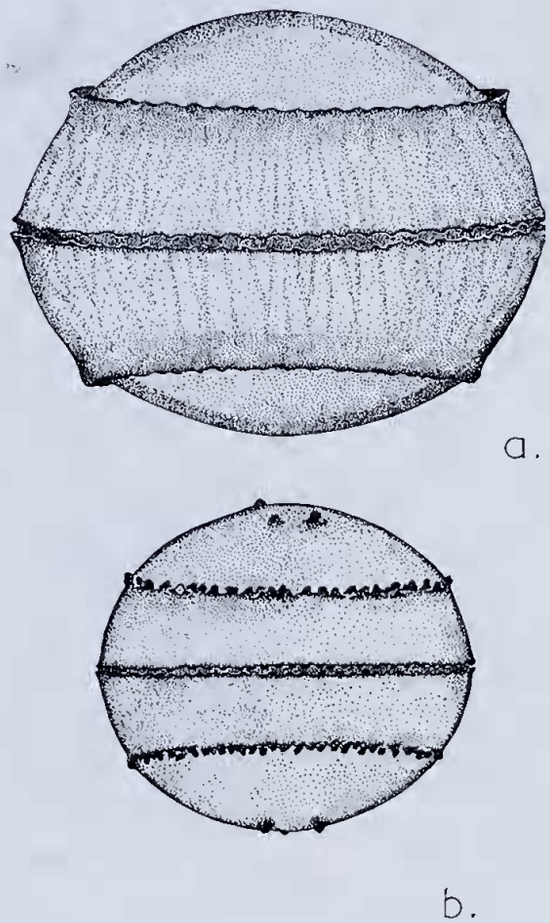

Figure 4.—a, *Peltacystia calvitium* Balme and Segroves. Reconstruction of intact specimen in equatorial view. b, *Peltacystia monile* Balme and Segroves. Reconstruction of intact specimen in equatorial view. Both reconstructions X 1000.

Dimensions.—Equatorial diameter (20 specimens) 44-59μ (mean 50μ).

Descriptions.—Holotype: intact specimen preserved in equatorial view, equatorial diameter 52μ, polar diameter 44μ, wall thickness 4μ in polar region. Striae of equatorial zone clearly defined. Paratype 54002: intact specimen in polar view, equatorial diameter 58μ. Paratype 54003: intact specimen in equatorial view, equatorial diameter 53μ, polar diameter 44μ.

Locus typicus.—Coal at 91-95 feet, U.W.A. 4 (Woolaga Creek) Borehole, Perth Basin, Western Australia. Wagina Sandstone, Upper Permian.

Derivatio nominis.—Latin *calvitium* = a bald head.

Remarks and comparisons.—*Peltacystia calvitium* was abundant in the type material but has not been frequently encountered elsewhere. Rare specimens of *Peltacystia* occurring in Artinskian sediments from the Canning Basin are similar to *P. calvitium*, but they have not been studied in enough detail to be sure of their identity.

Peltacystia calvitium differs from *P. venosa* in its well-defined circumpolar ridge which lacks heavy additional processes and in the absence of sculpture in the polar zone. *P. monile* is smaller than *P. calvitium* and lacks the pronounced circumpolar ridge.

Known stratigraphic range.—?Artinskian—Upper Permian.

Distribution

Apart from the type locality the various species of *Peltacystia* have been recorded from a number of other localities in Western Australia, especially in bores in the Wicherina-Eradu area. These bores were sunk by various companies engaged in coal exploration or by the Public Works Department of Western Australia, as part of its hydrological programme. Locations of some of the bores listed from the Perth Basin may be found in the publication by Johnson, De la Hunty and Gleeson (1954) and those of the remainder in the unpublished thesis by Olgers (1959) which is lodged in the Library of the University of Western Australia. With the exception of the Noonkanbah Formation, the formations from which the samples listed below were obtained are all considered to be Upper Permian.

Perth Basin

Peltacystia venosa.—Eradu Coal Bore No. 1, 640 feet; Eradu Coal Bore No. 5, 135-157 feet; Eradu Coal Bore No. 8, 172-211 feet; Eradu

Coal Shaft, 144-161 feet; P.W.D. Bore X48 Wicherina, 397-403 feet; P.W.D. Bore X49 Wicherina, 200-225 feet, 367-373 feet.

Peltacystia monile.—Eradu Coal Bore No. 8, 172-211 feet; Eradu Coal Shaft, 144-161 feet; P.W.D. Bore No. 48 Wicherina, 397-403 feet; P.W.D. Bore X49 Wicherina, 367-373 feet.

Peltacystia calvitium.—Eradu Coal Bore No. 1, 640 feet; P.W.D. Bore X48 Wicherina, 256-258 feet, 391-397 feet, 397-403 feet, P.W.D. Bore X49 Wicherina, 200-225 feet.

Collie-Muja Basin

Peltacystia venosa.—Cardiff Main Seam, Cardiff Colliery; Griffen Seam, Griffen Colliery; Muja No. 1 Bore, 50 feet.

Peltacystia monile.—Cardiff Main Seam, Cardiff Colliery; Griffen Seam, Griffen Colliery.

Peltacystia calvitium.—Griffen Seam, Griffen Colliery.

Canning Basin

Peltacystia venosa and *P. monile* have been recorded from the Liveringa Formation at several localities, but neither species is common in any material so far examined. A form resembling *P. calvitium* occurs rarely in sediments assigned to the Artinskian Noonkanbah Formation in B.M.R. 1 (Jurgurra Creek) Bore.

Acknowledgments

We are indebted to the Director of the Geological Survey of Western Australia (Mr. J. H. Lord) for supplying samples from the Eradu Coal Bores and to officers of the Public Works Department who co-operated in the collection of material from water borings in the Wicherina district.

Photomicrographs are the work of Mr. K. C. Hughes of the Department of Geology.

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